FOREST PEST MANAGEMENT

EFFECTS OF APPLICATION RATE AND TIMING OF ETHEPHON TREATMENTS ON ABSCISSION OF PONDEROSA PINE DWARF MISTLETOE

by

David W. Johnson
Supervisory Plant Pathologist

United States Department of Agriculture

Forest Service

Forest Pest Management
Denver, Colorado

EFFECTS OF APPLICATION RATE AND TIMING OF ETHEPHON TREATMENTS ON ABSCISSION OF PONDEROSA PINE DWARF MISTLETOE

by

David W. Johnson
Supervisory Plant Pathologist

Diane M. Hildebrand
Plant Pathologist

Frank G. Hawksworth
Research Plant Pathologist

Technical Report R2-44

January 1989

Timber, Forest Pest, and
Cooperative Forestry Management
Rocky Mountain Region
USDA Forest Service
11177 W. 8th Avenue
Lakewood, Colorado 80225

ACKNOWLEDGMENTS

The field assistance of Linda Fahey, Biological Technician, is greatly appreciated. Special thanks to Charles Hicks, Rhone-Polenc Ag. Co. for chemicals; Byron Reid, Hutchinson Pest Control, Inc. for applying the chemicals; and Bob Goss, Black Forest Camp and Conference Center, for arranging applications, recording weather data and providing use of forest land for treatments.

ABSTRACT

Previous research in Colorado has shown that application of the ethylene-releasing growth regulator ethephon effectively causes shoot abscission of the dwarf mistletoe Arceuthobium vaginatum subsp. cryptopodum in ponderosa pine when applied in June. Further tests in the Black Forest, north of Colorado Springs, Colorado, were made in 1988 to determine the relative effectiveness of applications made in mid-June, mid-July, and mid-August. Ethephon was applied at rates of 2200 and 2700 ppm and a water control with a commercial hydraulic sprayer. No significant difference in results were obtained from the two application rates and shoot abscission rates of 73 to 98 percent were obtained. Similarly, there were no significant differences in results from the applications on the three dates. Thus, we conclude that ethephon may be applied to ponderosa pine dwarf mistletoe any time during the summer to cause shoot abscission and minimize spread of the parasite.

INTRODUCTION

A safe and effective chemical control for dwarf mistletoes has been an elusive goal of forest pathologists for many decades. Nearly 60 different chemicals have been tested, most were various formulations of 2,4 -D or 2,4,5 -T. None of the chemicals tested were effective in killing mistletoe plants without injuring the host tree.

Recently much interest has been generated regarding the use and effectiveness of the plant growth regulator, ethephon, in reducing spread of mistletoes. This interest has been stimulated as pest control specialists continue to seek alternative methods of controlling mistletoes, particularly in high-value trees.

The activity of ethephon (2-chloroethylphosphonic acid) as a plant growth regulator lies in its ability to release ethylene when absorbed in plant tissues. Ethylene causes abscission of dwarf and leafy mistletoe shoots and thereby prevents spread via seed production and dispersal.

Since 1982, tests have been conducted on two species of dwarf mistletoe in Colorado; lodgepole pine dwarf mistletoe (Arceuthobium americanum) and ponderosa pine dwarf mistletoe (A. vaginatum).

High rates of abscission of dwarf mistletoe shoots in these previous tests have encouraged further testing of the chemical to determine the optimum application rates, timing and equipment to obtain the best results for several species of western dwarf mistletoes.

The objectives of this study were to determine the most effective rate, timing and duration of effectiveness of ethephon treatments on A. vaginatum.

METHODS AND MATERIALS

An area of heavily infected ponderosa pine was selected for the study in the Black Forest north of Colorado Springs, Colorado on property owned by the Baptist Assembly Black Forest Camp (Fig. 1).

Two application rates of ethephon (Chipco Florel R Pro Brand Plant Regulator), 2200 ppm and 2700 ppm with nonionic surfactant (Ortho X-77 Spreader) in water and the control, surfactant alone in water, were tested. Treatments were assigned by random selection of treatment plots containing about 10 trees each.

Thirty non-systemic female infections were randomly selected in the lower crowns of pines for each treatment, usually three infections per tree. The numbers of shoots in each infection had to be small enough for accurate counting. Each infection was labelled with a metal tag and numbered for subsequent observation. The number of shoots on each infection was determined and recorded a day or two just prior to treatment. A photographic record was also made of selected individual infections.

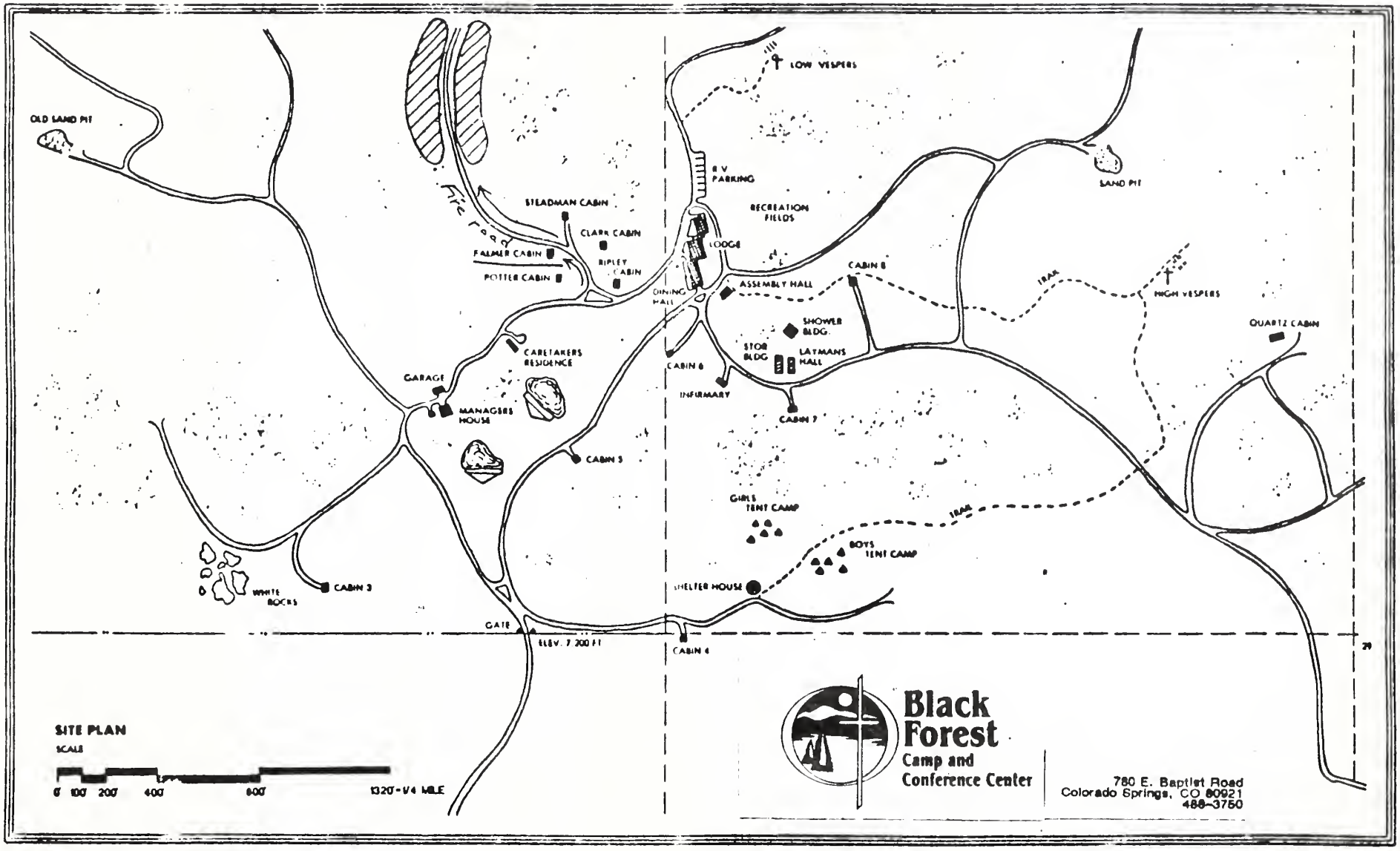

Figure 1. Location of ethephon test area
Black Forest Camp and Conference Center, Colorado Springs, CO

Groups of treated trees.

Applications were made in mid-June, mid-July and mid-August with a commercial hydraulic sprayer unit fitted with three separate tanks. At each application date, the equipment was calibrated to determine the length of time to apply five gallons of mixed spray. Each tree was sprayed with 3-5 gallons. This was sufficient to cover the tree thoroughly to runoff since the trees were of short stature, 20 to 40 feet high. The applications were made during warm, sunny weather to obtain maximum effectiveness of the chemical.

A summary of the study design follows:

Treatments with 30 infections in each: 2200 ppm ethephon with 0.1% surfactant in water; 2700 ppm ethephon with 0.1% surfactant in water; and control 0.1% surfactant in water alone.

Application dates: June 16, July 13 and August 17, 1988.

Daily high temperature and rainfall was recorded from application date and thereafter for 5 days.

RESULTS AND DISCUSSION

Weather during and immediately following application was favorable to achieve optimum release of ethylene and subsequent abscission of dwarf mistletoe shoots (Table 1). Temperatures ranged from 75-100 F at time of application and 80-96 F the following 5 days. Although light amounts of rainfall occurred immediately following application on July 13 and August 17, abscission rates were excellent.

Four weeks after each application, the previously tagged infections were evaluated. The number of mistletoe shoots were counted as before. Results are presented in Table 2. Excellent abscission of shoots was obtained with each application compared to controls. The difference between the 2200 and 2700 ppm rate did not appear to be significant. After mid-July, small shoots (nubbins) were seen developing on all treatments. These were immature shoots with no fruit, thus they do not yet pose a threat in spreading the disease. At this time natural abscission was developing as evidenced by the decrease in shoots on controls (14%)(Table 2). Much insect activity was noted in August, including feeding by larvae of the butterfly Mitoura spinetorum.

Ethephon does not appear to provide long-term control of dwarf mistletoes but, by causing shoot abscission, it can substantially reduce the spread of the parasite. The growth regulator seems to have little effect on the mistletoes' root system which is embedded within the cortex and wood of the host tree. Thus, the effects of the growth regulator are temporary and new shoots, and eventually new fruits, will develop from the living mistletoe root system.

Additional evaluations of all applications are planned yearly until development of mature mistletoe shoots and fruits occurs. This information is essential to determine when repeat applications of the chemical are needed for effective reduction of disease spread.

Table 1. Daily high temperature and rainfall, recorded at the Black Forest Camp and Conference Center, Colorado during and after application of ethephon to dwarf mistletoe-infested ponderosa pine during the summer of 1988.

Date	Temperature (F)	Rainfall (Inches)
June 16*	81	0.0
17	80	0.0
18	90	0.0
19	91	0.0
20	90	0.0
21	96	0.0
July 13*	100	0.10
14	85	0.30
15	88	0.0
16	95	0.0
17	95	0.0
18	80	0.0
August 17*	75	0.80
18	80	0.0
19	94	0.0
20	80	0.0
21	85	0.0
22	-	0.20

* Application dates.

Table 2. Results of ethephon applied by hydraulic sprayer at monthly intervals for dwarf mistletoe on ponderosa pine, Black Forest, Colorado, 1988.

Treatment	Application date		
	June 16	July 13	August 17
	Percent change in number of shoots after 4 weeks		
Controls	0	-14	+20
2200 ppm	-87	-84	-73
2700 ppm	-86	-98	-93

LITERATURE ON THE USE OF ETHEPHON FOR MISTLETOE REDUCTION

Brungardt, S. 1985. Researchers play Scrooge to a dangerous and stubborn mistletoe. Minnesota Sci. 4:11-13.

Fritz, C. D. 1989. Abscission of dwarf mistletoe shoots with ethephon. Proceedings Plant Growth Regulator Society of America (In press).

Han, S., A. M. Berry, and M. S. Reid. 1988. New ways to control mistletoe. California Weed Conference Proceedings 1988:42-45.

Hawksworth, F. G. and D. W. Johnson. 1989. Panel - Mistletoe control with ethephon. Proceedings of the 36th Western International Forest Disease Work Conference (In press).

Johnson, D. W. and F. G. Hawksworth. 1988. Reduction of ponderosa pine dwarf mistletoe with the plant growth regulator ethephon. USDA Forest Service, Timber, Forest Pest and Cooperative Forestry Management, Rocky Mountain Region Tech. Rep. R2-42. 10 pp.

Joyce, D., K. Rein, M. Reid, and A. Berry. 1986. Use of ethephon for control of broad-leafed mistletoe in deciduous trees. HortScience 21:872 (Abstract).

Joyce, D. C., K. Rein, A. M. Berry, and M. S. Reid. 1987. Control of broadleaf mistletoe (Phoradendron tomentosum) with dormant season ethephon sprays. Acta Horticulturae 201:141-144.

Livingston, W. H. and M. L. Brenner. 1983. Ethephon stimulates abscission of eastern dwarf mistletoe aerial shoots on black spruce. Plant Disease 67:909-910.

Livingston, W. H., and M. L. Brenner. 1983. Ethephon, a plant growth regulator, stimulates abscission of eastern dwarf mistletoe (Arceuthobium pusillum) aerial shoots on black spruce (Picea mariana). p. 104-106, In: Proceedings of 30th Western International Forest Disease Work Conference, Sept. 12-16, 1982, Fallen Leaf Lake, CA.

Livingston, W. H., R. A. Blanchette, M. L. Brenner, and K. J. Zuzek. 1985. Effective use of ethylene-releasing agents to prevent spread of eastern dwarf mistletoes on black spruce. Can. J. For. Res. 15:872-876.

Moinat, A. 1988. Chemical control of dwarf mistletoe of pine. Progress Report for 1988. Estes Park, Colorado, Unpublished Report, 3 p.

Nicholls, T. H., L. Egeland, F. G. Hawksworth, and D. W. Johnson. 1986. Control of dwarf mistletoe with ethephon, p. 78-85, In: Proceedings of 34th Western International Forest Disease Work Conference, Sept. 8-11, 1986, Juneau, AK.

Nicholls, T. H., L. Egeland, F. G. Hawksworth, D. W. Johnson, and M. K. Robbins. 1987. Control of dwarf mistletoes with a plant growth regulator, p. 154-156, In: Proceedings of a Technical Conference on Management of Subalpine Forests: Building on 50 Years of Research, July 6-9, 1987, Silver Creek, CO. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, General Tech. Rep. RM-149.

Robbins, M. K., D. W. Johnson, F. G. Hawksworth, and T. H. Nicholls. 1989. Aerial application of ethephon is ineffective for controlling lodgepole pine dwarf mistletoe. Western Journal of Applied Forestry (In press).